

POLICIES FOR SUSTAINABLE MANUFACTURING AND EXTENDED PRODUCER RESPONSIBILITY FOR GREEN AND SUSTAINABLE MANUFACTURING IN INDIA – A REVIEW

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ABSTRACT

Sustainable Business is the need of the hour. This paper is an attempt to review the practices of sustainable manufacturing through innovative design and engineering attempts from the end of producers, shift of consumers towards more responsible consumption and focus of governments towards green and sustainable manufacturing by encouraging them with favorable policies, funding and taxation benefits. The study is in the policy context of India. Triple bottom line frameworks, the concept of circular economy and extended producer responsibility have been the background of the study.

KEYWORDS: Manufacturing, Triple Bottom Line, Sustainability, Environment & Recycling

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INTRODUCTION

The Concept of Sustainable Manufacturing

It is important to understand the meaning of sustainable development before migrating to sustainable manufacturing. Brundtland Commission (1987) defines it as development that “meets the needs of the present without compromising the ability of future generations to meet their own needs”

Rosen and Kishawy (2012) describe sustainable development in context of social, economic and environmental concerns that should be addressed at the same time and in a holistic manner in the development process.

Jawahir et. al (2013) say that sustainable manufacturing, ‘at the product, process and systems levels must demonstrate reduced negative environmental impact, offer improved energy and resource efficiency, generate minimum quantity of wastes, provide operational safety and offer improved personnel health, while maintaining and/or improving the product and process quality with overall lifecycle cost benefits’.

Evolution of Sustainable Manufacturing

According to Jovane et al (2008), manufacturing in its traditional form was focused mainly on cost optimization. Environmental concerns were only limited to the extent of cosmetic importance and a little towards health and hygiene. Its base was substitution for cost minimization. It later, in early 1900’s the evolution of Toyota Production System, and lean manufacturing happened with the aim of reducing waste and increasing efficiency leading to better quality. Then evolved the Green manufacturing which include the principles of sustainable design,

LCA (Life Cycle Analysis) and pollution prevention. Its focus is on environment aspect of the triple bottom line with the 3 Rs principle of – Reduce, Reuse and Recycle.

Sustainable manufacturing is the evolved form of manufacturing focusing on 6 Rs aimed towards the concept of maximizing Stakeholder's value. It can be understood from Figure 1.

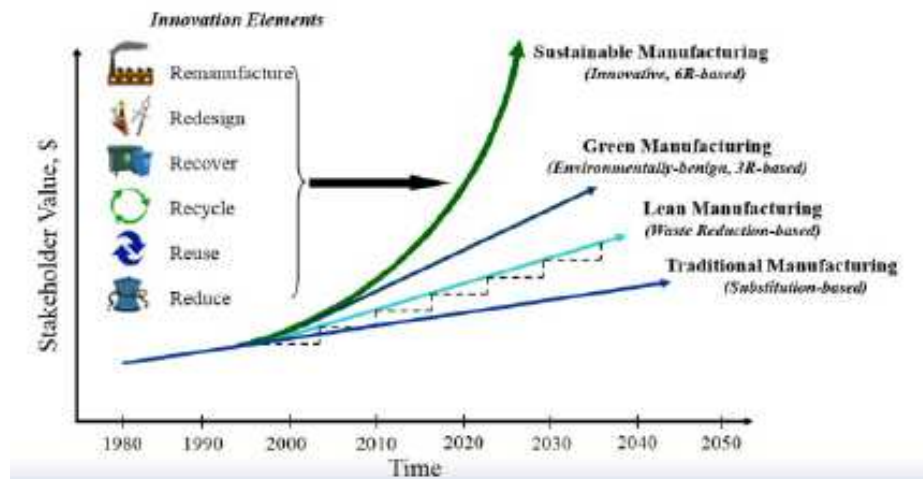


Figure 1: The Evolution of Sustainable Manufacturing (Source: Jovane et al, 2008)

In this article, an attempt has been made to understand sustainability in the field of manufacturing from the environmental and economic value creation perspective. This includes consideration of relevant environmental issues, green manufacturing, life cycle factors, and priorities in advancing manufacturing operations and processes. Sustainability finds application in many sectors including design, engineering and manufacturing. Manufacturers around the world are becoming progressively more concerned about the subject of sustainability. The industry is now recognizing the relationship between manufacturing operations and the natural environment. And, sustainability has now become an important factor in strategic decision making.

As per the triple Bottom line approach (Elkington, 1994), sustainability can be viewed as having three parts: planet (environmental bottom line), profit (economic bottom line) and people (or social equity bottom line). As a result, it requires an integrated approach and multi-dimensional indicators that link a community's economy, environment and society to achieve sustainability. Figure 2 gives a diagrammatic interpretation of Triple Bottom Line and Table 1 points out the indicators of sustainability.

Sustainable manufacturing and development needs support from all stakeholders and mainly from the producers, consumers and the policy makers in order to successfully implement good practices and generate value, which is cherished by the society and community along with long term profitability for the producers. The classification of agents of sustainable manufacturing is diagrammatically represented in Figure 3.



Figure 2: Triple Bottom Line Approach for Sustainability

Table 1: Some Indicators of Sustainability Based on Triple Bottom Line

Profitability	Planet	People
Income of the employee	Concentration of SO ₂ , NO _x	Ratio of Women in work force
Cost of unemployment	Harmful and toxic pollutants	Average Household income
Creation and destruction rate of business	Excess nutrients	Relative poverty
Establishment size	Usage of electricity and Fossil fuel	Unemployment rate
Growth in employment	Waste & Effluent management	Share of degree holders in the entire population
Sector wise employment	Sewage Management	Average commute time
Sector wise percentage distribution of firms	Changes in land cover	Crime rate
Sector wise wealth contribution to GDP	PM 2.5 and PM 10 concentration, Air quality index	Life expectancy
Shareholder wealth maximization	Carbon Footprint	Mortality rate

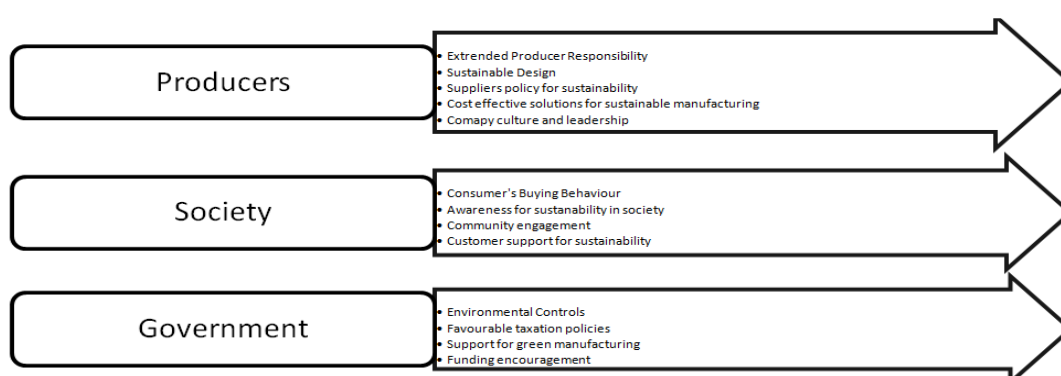


Figure 3: The Agents of Sustainable Manufacturing

Linear vs. Circular Economy

As per Sauve et al (2016), the concept of circular economy is based on production and consumption of goods through closed loop material flows that internalize environmental externalities linked to virgin resource extraction and the generation of waste (including pollution). On the other hand, linear economy has an opposite concept to that of circular

economy. In this, production and consumption of goods that (partially) ignore environmental externalities are linked to virgin resource extraction and the generation of waste and pollution.

Efforts towards a circular economy are gaining momentum. Since product's lifecycle is mostly determined during early product development phases, it is crucial to support those phases with explicit strategic directions. Sihvonen and Ritola (2015) examine the possibility to aggregate various definitions of end-of-life (EoL) strategies in a visually compelling way. They proposed taxonomy for communication between multidisciplinary product development teams using ReX, an abbreviation for alternative EoL strategies starting with prefix 'Re', such as reduce, reuse, repurpose, repair, remanufacture, recycle, and recover.

Different interpretation of these 6 Rs have been given by researchers. The table 2 is an attempt to classify the role of producers, consumers and government in implementing 6 Rs of Rethink, Refuse, Reduce, Reuse, Repair and Recycle.

Table 2: 6 Rs of Circular Economy

6 Rs	Producers' Role	Consumers' Role	Governments' Role
Rethink	Innovative product design and constitution, better supply chain and efficient usage	current lifestyles	To rethink future implications of current lifestyle and make policies
Refuse	To manufacture environmentally hazardous	Refuse to buy material involving hazardous chemicals and unethical labour practices	To stop/ limit giving permission to operate and produce environmentally and socially hazardous material
Reduce	Reduce wastage of material, bring in efficient quality systems	To reduce unnecessary consumption and adopt conscious purchase	Incentives for reduction in carbon footprint and achieving green goals
Reuse	Reuse material, work on circularity of supply chain	Innovative uses of material in alternative forms	Public awareness programmes on reuse
Repair	Invention of modular designs so that parts can be changed and repaired instead of discarding the whole material, attractive warranty schemes	Conscious effort to reuse the material after repair	Public awareness and incentives for sustainable manufacturing and innovative designs
Recycle	Conscious effort to recycle material keeping in mind the energy expenditure and cost effectiveness	To develop taste for recycled items	Promote recycling through centralized policies and laws

The Role of Government in Policy Making to Support Sustainable Manufacturing and Circular Economy

India, as of now, is in a cusp of development. Due to a large and relatively young population, the demand of resources is growing to meet human aspirations in the form of their needs wants and desires for better living standards. However, the challenge ahead for the economy is to secure these resources at affordable rates with minimum environmental damage and maximum positive societal impact. The challenge for the government is to create the right balance between the requirement of fast paced development as well as minimizing the negative externalities linked to resource use. Designing new and innovative policies can create a supporting framework for achieving resource efficiency, thereby addressing larger goal of circular economy. One of the most notable policies that India introduced more than a decade ago that displayed the spirit of sustainable development was the National Environment Policy (NEP) of 2006.

The policy mentions that only such development is sustainable, which cares for ecological constraints and the imperatives of social development and justice. Over the last years, India has slowly moved from a command and control type of regulatory environment towards regulation based on use of economic instruments. The Table 3 given below presents the classification of government policies based on various stages of production life cycle. It also summarizes the various policy initiatives taken by Indian Government.

Table 3: Indian Policies to Promote Circular Economy and Sustainable Manufacturing (Compiled from Circular Economy: A Business Imperative for India, www.teriin.org)

Classification of Policies at Different Life Cycle Stage	Relevant Laws and Programmes
Policies for facilitating resource efficient mining practices	National Mineral Policy (2008), Sustainable Development Framework for Mining Sector in India (2011), Minerals and Mining Development Regulatory Act (MMDR)(2016)
Policies for facilitating Resource Efficiency During product Design phase	National Design Policy (2007), Science Technology and Innovation Policy 2013, Bureau of Indian Standards Act (2016)
Policies for facilitating Resource Efficiency in Manufacturing in India	National Manufacturing Policy 2011, National Policy on Electronics (2012), National Manufacturing Competitiveness programme 2014, Financial Support to MSME's in Zero Defect Zero Effect Certification Scheme (2017)
Policies to Promote Resource Efficiency at the consumption Phase	Eco- Mark labeling scheme (1991), Bureau of energy Efficiency Star labeling programme (2006), Bio-fuel Programme (2009), Renewable energy Certifications (2010), Perform Achieve and Trade (PAT) scheme (2012), Auto Fuel Policy (2015), National electric Mobility Mission Plan (2015)
Policies to promote resource efficiency through efficient disposal of waste / end of life products	Fly Ash Utilization Policy (1999), Batteries (Management and Handling) Amendment Rules (2010), Solid Waste Management Rules (2016), Construction and Demolition Waste Management Rules (2016), E-Waste (Management) Rules (2016)Plastic Waste Management Rules (2016)Hazardous and Other Wastes (Management and Transboundary Movement) Rules (2016)Reduction in GST on waste products 2017

Strategies for Promoting Sustainable Manufacturing in India

- Increase the competitiveness of Indian companies through a solid and innovative focus on sustainable and resource effective production and product design
- Focus on triple bottom line through circular economy initiatives and new jobs
- Set up sustainable business areas through closing material loops, increasing product lifeline, reuse and recycling of products
- To garner institutional support for conversion of waste to resources through waste prevention and resource efficiency
- Cultivate new competitive advantage among the bodies through exchange of experiences and knowledge sharing in innovation networks between industry, authorities, universities etc.
- To promote the collaboration and enhance the communication between manufacturers, waste management facilities and other relevant bodies on topics such as resource efficiency, innovative product design, business models and systems for closing material loops.

Key Focus Areas for Companies to Achieve Sustainability in Manufacturing

- Competitive product costing (Through efficient production methods and product design)
- Focus on total cost of ownership (warranty and service schemes, or take-back systems, which can help keep the raw material and component prices down.
- Paradigm shift from products to product-service-systems for creating added value for the customers (i. e. keeping the production costs low and the potential for a higher sales price and closer customer relations). An added benefit of resource efficiency and sustainable production is that, the vulnerability of the industry towards increasing raw material prices and unstable supplies is reduced.

Extended Producer Responsibility in India and the Way Ahead

As per OECD, Extended Producer Responsibility or EPR norms are made to bring in circularity in the economy and promote the 6 Rs. EPR makes the waste sector a more formal one by setting up financial cost standards and environmental standards. It is a product policy. The basic idea is around innovative product design shift, effective waste management for better environment, financial, physical and information responsibility of waste generated. Indian Government needs to make policies and define the roles and responsibilities. As of now, the auditing and monitoring is not sufficient in India. EPR is present in the manufacture of Lead batteries, plastic waste, E-Waste, Fluorescent mercury based lighting, packaging goods and sanitary pads.

However, major recycling is done by the informal sector, due to which the overall integrity of concept has not been adapted well. Moreover, the recycling process uses high amount of energy, and it is considered hazardous and unsafe in many situations. Dedicated team work from the side of government, industry and society for making a formal waste sector, and focus on research and development on circular economy concepts can make manufacturing processes more sustainable.

CONCLUSIONS

An integrated approach towards sustainable manufacturing is needed with focus on innovative designs for design and life cycle assessment. Keeping in mind the UN sustainable development goals there should be a focus on creation of an ecosystem that adopts and promotes sustainable manufacturing practices. This is only possible if there is a relevant legal framework. Also, collaborative efforts by manufacturers, academia, society and others is the need of the hour. Manufacturers should adopt a focus for sustainability and establish a sustainability culture within their companies and in their associations to be successful in enhancing sustainability in design and manufacturing. Extension of extended producer responsibilities and circular economy in other areas of manufacturing other than existing ones should be a priority. Manufacturing firms need to be competitive and profitable but at a same time they must be responsible towards environment and society which will in turn make them much sought after by investors and help in getting government benefits.

Predicting the future of sustainable manufacturing is difficult. Triple bottom line accounting focuses on people, profit and profitability almost equally. The companies in times of economic uncertainty tend to move their focus on profitability and productivity. However environmental pressures time and again move them back on the past of sustainability. The future indeed needs to be bright.

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